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Crowdsourcing Urban Accessibility: How to attract large user base and obtain precise data

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Abstract. People impaired in mobility have much higher requirements regarding information about accessibility when planning their everyday journeys. Usage of the professionally created sidewalk-based geodatabase is a solution. However, the professional onsite reconnaissance is highly time and cost demanding. One of the proposals is to achieve this data mining by geo-crowdsourcing approach as an alternative to professional reconnaissance. This extended abstract presents results of the research focused on designing the mobile application for collecting accessibility attributes by non-expert crowd which will reduce time and cost of the professional data collection.

1 Introduction

In order to satisfy special requirements of people with limitations in mobility regarding route accessibility a navigation system, which uses a sidewalk-based geodatabase and provides users with accessibility attributes of pedestrian segments [1] should be introduced. Currently, the geodatabase is filled via professional onsite exploration which is highly cost- and time-consuming. One of the proposal how to reduce these costs and speed up the data collection is by crowdsourcing approach [2]. Our aim is to design a crowdsourcing mobile application for collecting obstacles and accessibility attributes, which will be widely used and will collect precise and relevant data for safe and independent navigation of handicapped people.

2 Qualitative research

We must encourage people to get involved into geo-crowdsourcing to make sure we collect sufficient amount of relevant data. After conducting semi-structured interviews with 9 respondents, we have found out that the most compelling stimuli to increase user engagement are: monetary payments, altruism, amusement and useful information. For our application, we have decided to explore gamification as a motivation tool further in depth. It is lower in cost in comparison to monetary payments, does not clutter application with subjective data which might be redundant for navigation of impaired people, and it acts on a competitive side of human nature.

3 Evaluation

To support user engagement and increase user contributions we designed an additional gamified layer of reward and reputation system with points, badges and leaderboards (see Fig. 1). Each time user marks new obstacle, collects or validates data, he/she receives points which are shown on monthly and overall leaderboards. Every month there is a special gaming challenge to win extra points. Users can decorate their walls with badges and trophies gained for being active participants and share their contributions through social networks.

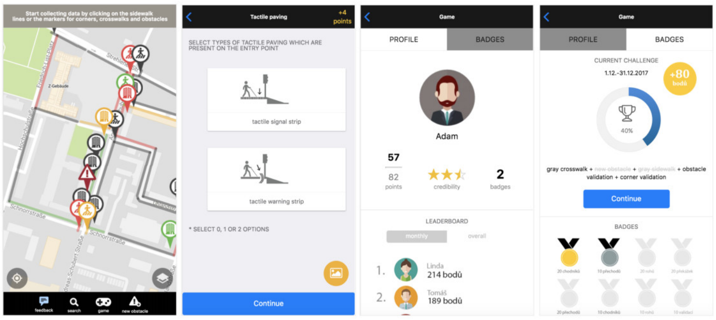

Fig. 1. Design of mobile application

4 Conclusion and Future Work

The evaluation results suggest the feasibility of this approach with a few design changes to implement. We plan to conduct a long-term experiment which will evaluate the quality of collected accessibility attributes in comparison to data obtained by the professional gathering and will review impact and effectiveness of the gamified layer on users' motivation to participate in geo-crowdsourcing.

Acknowledgements The research has been supported by the project Navigation of handicapped people funded by grant no. SGS16/236/OHK3/3T/13 (FIS 161 – 1611663C000).

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SuSy: Surveillance System for Hospitals

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Abstract. We present a prototype of Surveillance System developed as a part of an indoor navigation system. The related indoor navigation system uses video-detection for identification of navigated users and employs various terminals. In the Surveillance System, we focused on further utilization of audiovisual data from those terminals and using computer vision we aim to increase safety and security in large public buildings. In the design and prototyping phases, we followed the User-Centered design methodology.

1 Introduction and related work

In a hospital, according to [1], 16.2% of medical doctors and 21.9% of nurses have faced physical violence. In the design of SuSy, we address this problem. We follow prior work [2, 3] focused on the development of navigation system for interiors. The InHospital Navigation System is designed mainly for use in healthcare facilities. In the navigation process, navigation terminals placed in the interior show personalized navigation instructions to the users using video-recognition. In SuSy, we utilize video streams of navigation terminals.

2 Method

Firstly, we conducted qualitative user research (semi-structured interviews) with hospital employees and operators of surveillance systems. Based on the results of the research, we defined scenarios supported by SuSy: resolving health threats and security issues, tracking problematic patients, answering a question of a visitor, and we implemented them in several prototypes. To increase the situational awareness of the operator, we employed methods of computer vision to trigger events. For displaying, analyzing and resolving such events, Alerts were designed. Based on the type of Alert, a different tool for resolution of the problem is offered.

3 Evaluation

Each created prototype was evaluated in a usability study. The tasks were focused on elementary interaction with SuSy and the process of resolving the Alerts. The results show that the process of problem-resolving is intuitive and useful. However, there remain issues to be solved, e.g., elimination of distraction from different parts of the UI.

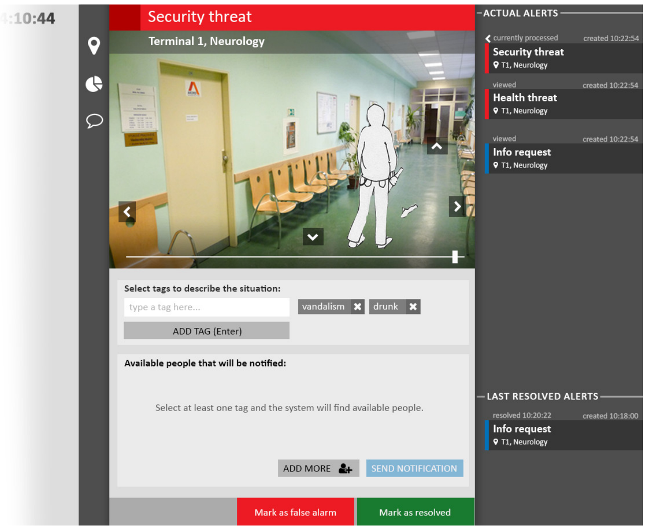

Fig. 1. High-fidelity prototype of SuSy – example of Security Threat Alert

4 Conclusion and Future Work

Based on qualitative user research, we designed a prototype of SuSy tailored for the hospital environment. Our design shows the ability to support SuSy's operator's tasks related to safety, security, and orientation. In the future work, we will focus on the higher use of automation. We also consider using multiple monitors and employing more interaction techniques (e.g., verbal dialog) to enhance the usability of the UI.

Acknowledgements This research has been supported by the Technology Agency of the Czech Republic under the research program TE01020415 (V3C – Visual Computing Competence Center) and by the project Navigation of handicapped people funded by grant no. SGS16/236/OHK3/3T/13 (FIS 161 – 1611663C000).

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Registration, Analysis, and Display of Indoor Rowing Motion in Real-Time

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Abstract

Low cost markerless motion capture devices like the second generation Kinect are a promising tool for motion recognition, especially since the data is available in real-time. With Kinect2Row we present a modular analysis application for indoor rowing motion. Our multithreaded processing pipeline gathers three dimensional joint data from the Kinect, segments the data streams into rowing strokes, calculates typical rowing measures and displays the results for the trainee. Despite the focus on indoor rowing, several modules of the pipeline can be reused for other movement patterns and future analysis systems.

1 Introduction

Indoor rowing is an all season training method with extensive training sessions, which cannot be continuously supervised by a trainer. Current rowing machines display temporal measurements, like applied force to the handle or stroke count, but lack a spatio-temporal representation of the whole body movement. Since each body segment is crucial for an effective rowing stroke, our idea is to observe the training on the rowing machine with a second generation Kinect, which provides full skeleton joint data in real-time. This data serves as input for our analysis application Kinect2Row, which contains a modular processing pipeline to convert the raw data into an understandable visualization. The goal is to provide an application with which athletes can observe their motions during the training on the rowing machine and improve their performance immediately.

2 Analyzing Rowing Motions

For the analysis of the captured rowing motion, we developed the processing pipeline described in Figure 1. To filter out jitter and noise that may be contained in the Kinect data stream of joint positions, we apply an adaptive double exponential smoothing filter (1€ Filter, [1]). We found out that for optimal skeleton recognition the Kinect has to face the person frontally with no joint covered. To meet these requirements, the sensor is placed at a height of ca. 2 meters, facing slightly down on the trainee. As a consequence, the coordinate

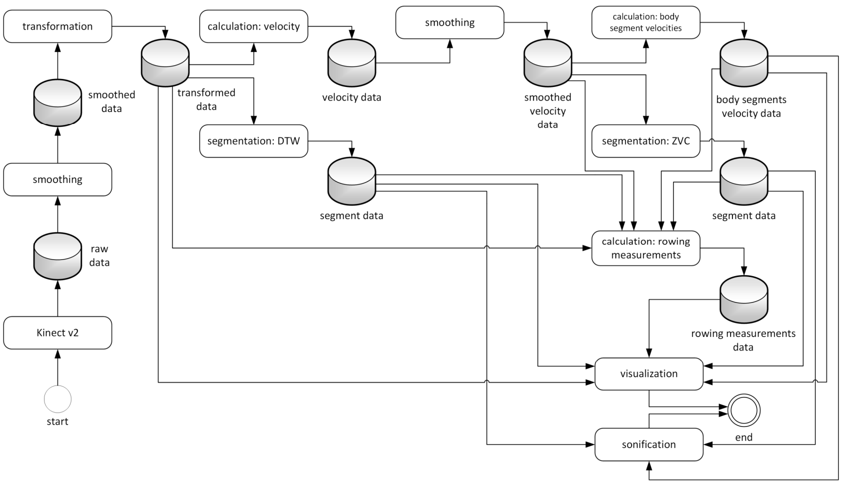

Figure 1: Kinect2Row processing pipeline.

system is rotated and needs to be transformed to the world coordinate system for an easily readable visual representation. Since rowing is a sport with cyclic motion and we want to analyze it based on rowing strokes, we propose two methods for segmenting the data streams in real-time. The first method determines zero crossings in the joint velocities [4]. This technique provides the start- and endpoints of segments with high precision. However, we have to deal with many false positive detections in slow movements, that do not match rowing cycles. As second method we applied the stream monitoring algorithm SPRING [5] which is based on Dynamic Time Warping. This technique detects a given template in the ongoing data stream by warping the time scale and classifying the matching segment with a distance measure. While detecting no false positive segments in rowing motion, the precision is not as high as with the first method. The smoothed and segmented joint data is then used to calculate various time- and position-based measures, which help the trainee to improve his rowing performance, e.g. the body center of mass [3], the body segment velocities and the trunk angle [2]. The results are finally displayed using a graphical user interface (see Figure 2) and an auditory display with a simple form of sonification.

3 Preliminary Results and Outlook

The first prototype of Kinect2Row was tested with a small target user group of four people with varying rowing skills. In our user tests the subjects on the one hand appreciated the trunk angle display and the side view of their skeleton including the hand- and center-of-mass-trajectory. These visualizations helped them self-monitoring their rowing performance and are not available in other current rowing applications. On the other hand, they disliked the display of biomechanical values, since they are typically not part of their training measures. They also noted that the sonification can become unpleasant in extensive training sessions. During the tests we found out that the usage of the Kinect

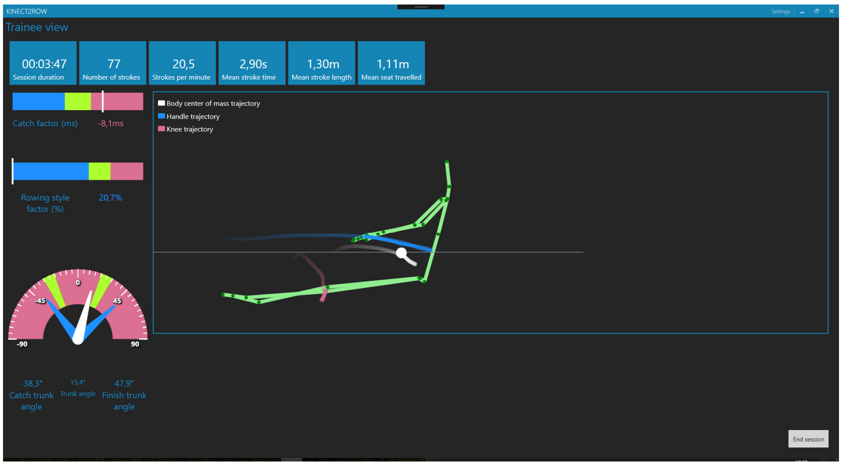

Figure 2: Graphical user interface of Kinect2Row.

comes with problems in detecting the hip and feet joints, because they are often covered by other body parts in certain stages of the rowing motion. These problems can be tackled by using alternative motion sensing hardware which can preferably register the joint positions from the side. The positive feedback for the spatio-temporal visualization also encourages further research to display other biomechanical values and improve the responsiveness of the application. The modules of the processing pipeline are task-based and can easily be reused for the analysis of other motion patterns.

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Detailed Modeling of the Human Body Surface in Motion

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Abstract. Physical simulation of muscles is computationally demanding and complex, whereas purely data-driven surface modelling lacks a biomechanical foundation. Our work aims at using both surface data and biomechanical data to learn a body model that strives to combine the advantages of the two approaches. We demonstrate a showcase of an elbow flexion model that exhibits believable muscular deformation effects of the biceps and triceps muscles while enabling control over the pose.

1 Motivation

Reconstructing the deformation of the skin surface in a realistic way is a challenging task. To model biophysical effects like subtle bulges muscles of muscles and tendons by direct physical simulation usually goes along with a high degree of complexity and is computationally intensive. Changes in the subject – e.g. in physiognomy and muscularity – require significant manual adjustments of such a physical simulation model, in order to reflect the nonlinear scaling of body part dimensions as well as the potentially different muscle deformation effects.

tend to imply a strong effort in scaling to the new body part dimensions. The alternative approach learns deformations from data, usually from surface data of multiple subjects and in multiple poses. For instance, previous work within our workgroup was based on learning deformations from multiple subjects performing various exercises under varying external forces [3]. This previous model can synthesize a mesh with a set of intuitive input parameters such as pose, body shape and even external forces. This delivered realistic deformations "out of the box", however excluding any biomechanical information necessary for medical purposes or for finer tweaking of the skin surface. Our ambition is to combine simulation-driven and data-driven modelling to a hybrid body model that enables the control of the skin deformation through a specific muscle activation pattern like biceps or triceps muscles and vice versa while being biomechanically consistent. This enables to make assumptions about distinct muscle activation patterns based on the skin surface without using any sensory devices for muscle activation measurements. At the same time the model allows separate control over pose and body shape. This not only enables more control over the muscle bulge deformation, but also opens up the range of applications to Computer Graphics, Therapy, Rehabilitation and Sports.

* This work was supported in part by ESF (grant number 100231931, TISRA).

2 Method: Correlation of surface and muscle data

We base our approach upon the SCAPE model by Anguelov et al. [1], and extend it with biomechanical data. Deformations are modelled with the use of deformation gradients as described by Sumner and Popović [4], thus, we solve for the triangle edges instead of the vertices. Fig. 1 gives an overview of the method workflow. The deformation gradient matrix can be split up into several parts. First, it contains the given body part rotations R, which can be used to normalize out the body pose and extract the mere displacement in the triangle edges of the undeformed and the deformed mesh. Secondly, it contains the required deformation induced by the muscle actuation and, thirdly, the pose-based deformation Q, both unknown. How can we separate both?

In order to first extract the pose-based deformation components Q, we learn any deformation occuring under motion (pose model), given the body part rotations R_{p} and providing those mesh training data samples recorded under minimal external forces (up to 1 kg of barbell weight).

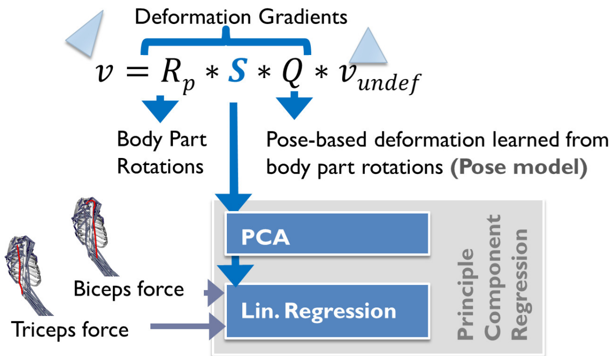

Fig. 1. Workflow of our proposed model

With the residual deformation component S – computed by subtracting the pose model – we go on and learn the muscle-specific deformation based on the biomechanical data. An inbetween Principal Component Analysis (PCA) step helps to prevent overfitting, selecting only the most meaningful Principal Components. As a result, we have a semantic model that, provided with pose specific parameters and a muscle activation pattern, delivers the respective deformation gradients to compute the resulting body surface.

3 Results

We demonstrate the described model in our showcase of an elbow-flexion motion with the shoulder-arm-model (cf. Fig. 2). Our training data is composed of reconstructed and registered meshes of the shoulder-arm area with 6 DoF of a male subject in an elbow flexion motion lifting up to 14 kg of barbell weight. The data had been captured through a multi-camera approach within previous work by Neumann et al. [3] within our work group. For each one of the several repetitions, we transferred the motion to OpenSIM [2] to simulate the biomechanical data in use, more specifically the muscle force data for the Biceps and Triceps regions. The strong coherence between the surface deformation and the muscle force data is visible in Fig. 3.

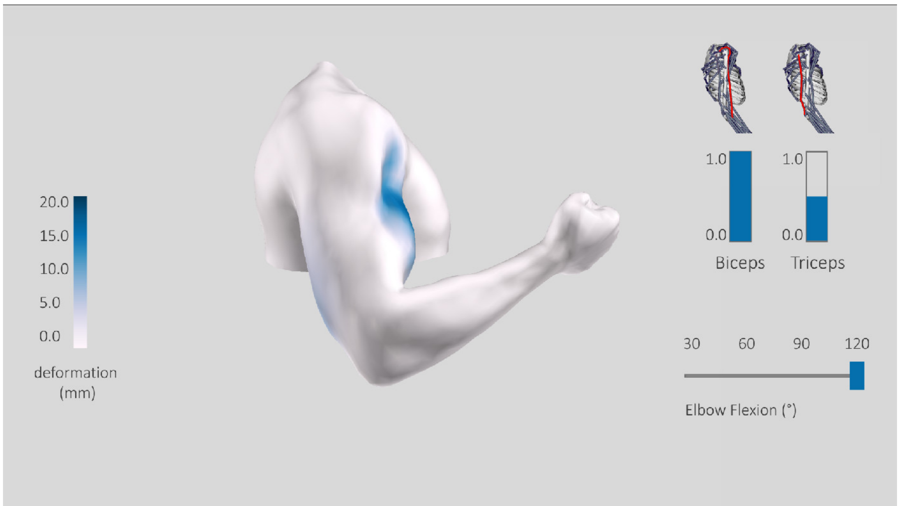

Fig. 2. We combine real world surface data of an elbow flexion motion with biomechanical simulation in OpenSIM to a hybrid surface model predicting the shape deformation from simulated muscle data, here shown with full biceps activation and halfway activated triceps in a flexed pose.

4 Conclusion

Our model can synthesize the skin shape from muscle activity and pose. It demonstrates plausible muscle deformation while enabling control of pose and shape. However, the demonstrated showcase is still limited, both in terms of pose and shape. Training on a larger dataset with respect to subjects, body parts and, especially, range of motion, will be essential to improve the generalisability. With this in mind, current work in progress aims at learning a similar model with the lower body data recorded within the TISRA junior research group, that offer a richrich dataset of registered meshes in even higher detail and with a rich set of motions recorded.

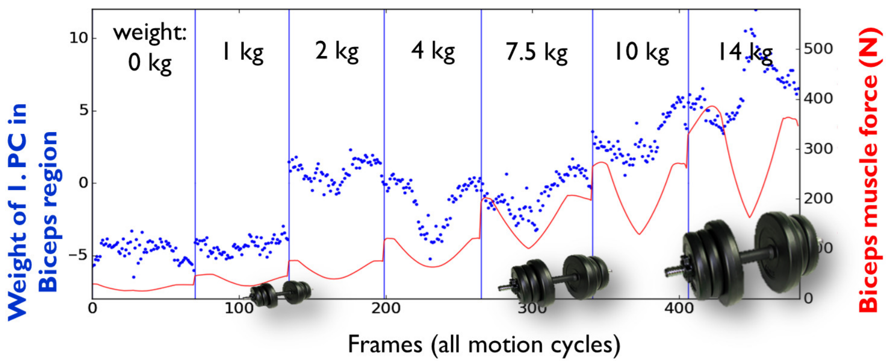

Fig. 3. The deformation change in the biceps region along the axis of the First Principal Component for several sequences of elbow flexion with increasing weights (blue) correlates well with muscle forces simulated with OpenSIM's Static Optimization tool (red).

The biomechanical data – limited to muscle force data in this proof of concept – could be extended to other subject-specific data like joint moments, muscle moment arms, EMG (electromyography) data or even pressure plate data. Apart from that, the definition of the muscle regions has been a manual process. An automatic detection of co-deforming areas in the surface is future work.

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Personal pill reminder for elderly and blind

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Abstract. Pill reminding is very helpful, especially for older people, who usually have to take multiple pills due to their health issues. In this work, we present requirements gathered from a blind elderly user in comparison with most popular pill reminder mobile applications. We also describe the first round of User-centered design (UCD) lifecycle of new pill reminder mobile application which attempts to solve shortcomings of already existing pill reminder applications.

1 Introduction

Elderly people today are already taking medications and using smarphones but they are many problems associated with it. Such as having to take every medication at different time and different time interval or not having any history of taken pills.

2 Related Work

We conducted a comparison of the most popular pill reminder mobile applications (Medisafe[4], MyTherapy[5], MedicineTime[1], CareZone[2], MyPillBox[3]), based of that comparison we created our set of user requirements and identified two main shortcomings of these applications.

1. Problem of not having enough medication with you when you are away from home.
2. Problem of having no real confirmation that the medication was indeed taken.

We want to prevent scenarios when user dismisses the notification and then forgets to take the medicine.

3 Design

For first problem we have decided to add interaction with a calendar into the application. User can then input time intervals, when he is away from home and application would then notice the user to take medications with him beforehand. As for second problem we decided for the need to scan medication barcode for notification to go away. We then created multiple prototypes according to our requirements. When creating prototypes we followed Google Material Design guidelines combined with standard pill reminder application layout which we obtained from our comparison.

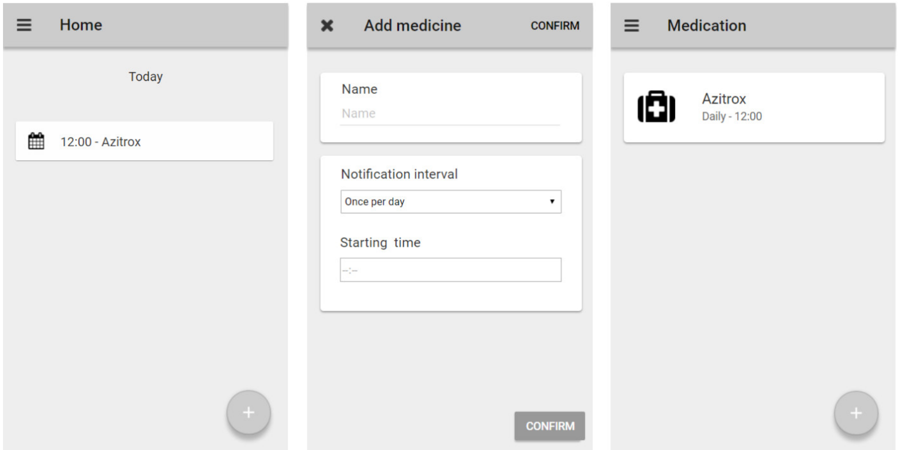

Fig. 1. Screenshots of created prototype

4 Evaluation

For our testing we created 4 basic use cases and scenarios that corresponds to our desired functionality of the application. We then tested these use cases on our prototypes with two elderly participants. The main purpose of this test was to test if user interface is intuitive. The testing showed us that the sliding navigation drawer is not easy for elderly to locate.

5 Conclusion and Future Work

We managed to create and test prototype of our application. Testing also showed us that the added functionality is desired. Next we need to perform evaluation on target devices and carry out further research on confirmation of taking medicine. We also need to take into account blind users, creating descriptive labels for screen readers.

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External labeling of non-convex areas

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Abstract. Educational text where complex relations between several objects are described is often accompanied by illustrations - a visual representation of the relations. Labels, short textual annotations, laid out around the illustrations mediate the interconnection between the verbal and visual representation of information. We present an algorithm capable of label layout calculation in real time. The algorithm is able to position the labels into non-convex areas around the illustrations.

1 Introduction and related work

In wide variety of fields ranging from medicine to mechanical engineering, multitude of complex objects can be encountered. Visual representation of these objects might provide an idea of their spatial arrangements, but inner workings of these objects must be described further textually. This linking of visual and textual representation is done utilizing labels. Based on the position of these labels, labeling can be internal or external. We focus on external labeling.

Our method is based on the method of Cmolik and Bittner [1]. Their method places labels around convex area enclosing the labeled object. This approach is not optimal for situations, where large part of screen is covered by this area, thus problem of insufficient space for label placement arises. Our approach tackles this issue with placing the labels at the boundary of the label object. Implementation was carried out as a part of bachelor's thesis [2].

2 Method

Firstly model division into individual areas is done, with each point within any given area being an anchor candidate. Leader line associated with a given anchor candidate is the shortest line connecting this candidate with the boundary of the labeled object. For every anchor candidate there is exactly one leader line associated with it and therefore we can impose several criteria on the properties of these leader lines. Many of these criteria are similar to those presented by Cmolik and Bittner [1], but criterion reflecting label overlap with labeled object and other labels must be added. Summed area table is used to facilitate calculation of this criterion, as it represents a time efficient way of evaluating this criterion. Upon aggregation of these criteria, labels are iteratively added in order that is opposite to sums of leader line candidates associated with given area. Furthermore, criteria are recalculated after placement of each label.

3 Evaluation

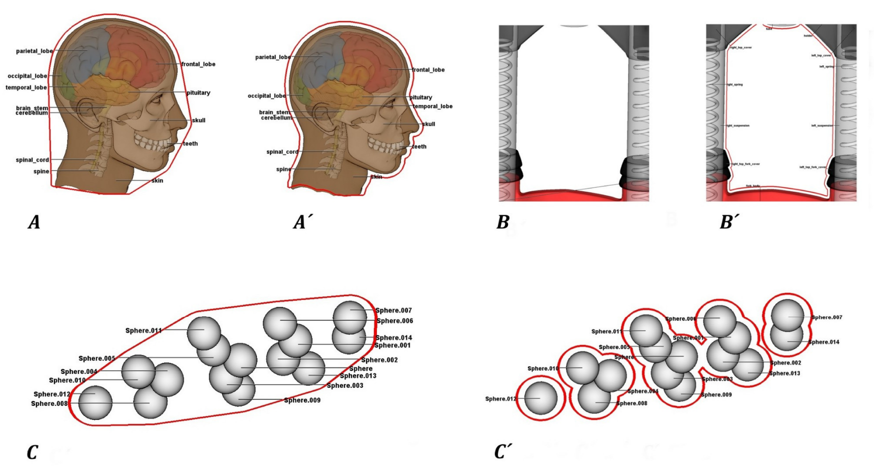

Fig. 1. Comparison of our method (A', B', C') and method of Cmolik and Bittner [1] (A, B, C)

Algorithm is able to place labels into non-convex areas and therefore the resulting label layout exhibits higher compactness than in case of [1]. Comparisons of results obtained utilizing our method to result obtain with method of Cmolik and Bittner [1] can be seen in Fig. 1. Our Algorithm is also only marginally slower that in case of [1] and for that reason is suitable for real time calculations.

4 Conclusion and Future Work

Presented algorithm places label directly at the boundary of labeled object. Resulting label layout therefore exhibits higher compactness than [1] due to more efficient utilization of free space.

In future we will explore methods of label placement into non-convex areas without usage of leader lines as this approach is suitable for certain applications.

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A tactile model for blind people to perceive graphic reproductions

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Abstract

Exhibitions are often designed for sighted visitors. Museums usually present paintings or objects behind glass and are rarely accessible for blind or visually impaired people. If available, audio and museum guides support visitors with special needs, but do not allow an autonomous exploration of exhibits. Audio stations and tactile models often lack explanations and are difficult to understand without additional information. With the penreader tiptoi® from Ravensburger we present a new solution for acoustic informations straight at the fingertips.

1 Introduction

Visiting a museum can create a multisensual experience. Nowadays, museums however often only stimulate mainly vision and partly hearing, thus blind and visually impaired people need to rely on their aural abilities. Tactile models are already available in some musuems, e.g. Hessisches Landesmuseum Darmstadt (HLMD, [5]), Meißen Albrechtsburg Castle [7], and Kunsthistorisches Museum in Vienna [12], however seldomly self-explaining. For this reason acoustic information offers like audioguides or explanations from chaperones or guides are very important. However, audioguides are not a given in all exhibitions. Chaperones and guides are more personal solutions but also limited. Furthermore blind and visual impaired visitors want to visit exhibitions autonomously and explore special offers like tactile models autonomously.
The Dresden State Art Collections (SKD) promote inclusion since years. For the special exhibition 'Revisiting Rome - Prints of the Eighteenth Century' in the Kupferstich-Kabinett in 2016 new methods for inclusion of blind and visually impaired people were planned. Current research in tactile models shows the importance of auditive explanations for blind and visually impaired people [4],[3]. To this end and as a model project, we created a barrier-free tactile model of the graphic 'The Round Tower' from Giovanni B. Piranesi in close cooperation with the curators. As the special exhibition provided no audioguides, we decided to use an interactive pen to extend our model with acoustic information. Moreover, with the camera at the tip of the pen we can give local context information to the visitor by tipping the surface with the pen. In this paper, we

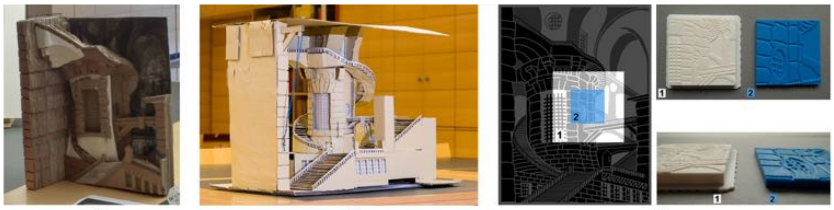
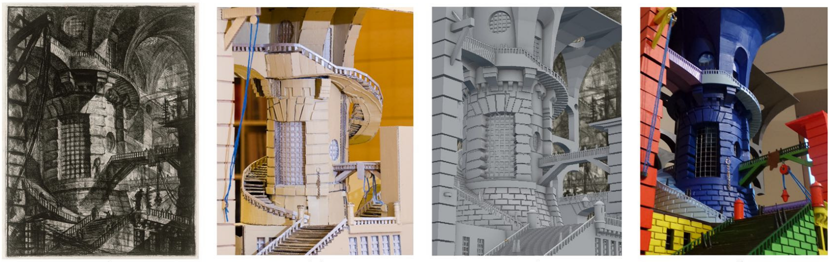


Figure 1: Prototypes of our tactile models a) relief made of carton [1], b) 3D model made of carton [8], c) base-reliefs of two different graphic parts, created with a 3D printer.

describe the workflow to transform digitized graphic reproductions into tactile models, which are extended by acoustic landmarks. We present technical and stylistic requirements to achieve an easily accessible model for both sighted and visually impaired or blind people.

2 Tactile Model

In comparison to sighted people, blind and visually impaired people perceive their environment substantially different. They have to rely on hearing and tactile impressions to capture their near surroundings [4]. In national and international exhibitions two different types of tactile models are common: reliefs and 3D models [5, 7, 12]. We evaluated both types with blind and visually impaired people. As a result, the users wanted to explore a spatial model with their fingers. They preferred a model dimension that allows them to differentiate details. Thus, we decided to refine the 3D model made of carton (cf. Figure 1b) for the exhibition. As a prototype made of carton is not robust enough for the long-term use in an exhibition, we wanted to produce the model by a 3D printer. For this, we had to transfer the model into a digital representation, which opened up additional challenges. In his work, Piranesi created a fantastic world and went beyond the rules of geometrically correct perspective [11]. As an example, the painting presents the tower from a low angle viewpoint, resulting in looking up the building (cf. Fig. 2a). However, in the artwork Piranesi shows the beginning of a circular staircase from a higher viewpoint, which in a spatially correct representation would be invisible to the observer. These perspective contortions and spatial distortions could not be transformed into a realistic, spatially consistent 3D model. Instead, we had to deduce a plausible architectural situation from the painting. With the help of an art historian we created a feasible, digital model (cf. Fig. 2c) and colored the different elements in contrasting colors. So, visually impaired people with at least low vision are able to differentiate roughly the parts of the model.
To meet the users' preferences learned from the user tests, we decided to print the model in a large size (LxHxW: 100x80x65cm). As 3D printers could not fabricate such big components in one piece, we had to divide the digital model into separate parts. To save time in the printing process, we divided it into sections for 3D printing and for laser cutting. Complex parts, like elements of



a) b) c) d)

Figure 2: Processing pipeline from the printed graphic to a tactile model for blind and visually impaired people. a) 'The Round Tower', from 'Carceri d'invenzione', printed graphic from Giovanni Battista Piranesi (second version, 1761) [9], b) prototype of carton [8], c) digital model, d) tactile model for blind and visually impaired people.

the round tower, were produced with the 3D printer. Simple ones, like straight stairs, were created with the laser cutter. Finally, all parts were colored and assembled to the full model (cf. Fig. 2d).
Our user tests additionally revealed, that a tactile model alone is not enough: Our target group wants and often needs context information straight at their fingertips.

3 Extension with tiptoi®

The reading pen tiptoi® was invented by Ravensburger as a learning system for children. The children use the pen to read aloud especially created books or products for the tiptoi® pen.

The tip of the pen consists of a camera which reads a small optical code (OID), which has to be printed on the sufrace of the products (cf. Fig. 3). The camera reads the optical code, the software searches for the code-id and playes a soundfile which is assigned to the code-id [2]. With the permission of Ravensburger we used the commandline tool "tttool" [10] to create our own tiptoi® application product.

For the model parts we created a sound hierarchy which can be accessed by the tip order. If the user tips an element for the first time he gets information about the architectural element or an introductory atmosphere sound. If he tips the element for the second time he gets more special information. Further tipping repeats the information hierarchy in a loop. This hierarchy was written in an YAML-file and converted to a tiptoi® readable GME-file.
To combine the tiptoi® pen and the tactile model we had to cover all surfaces with the optical codes we used in the program. Each optical code consists of 16 points on an area of 1mm^2 [6]. This code is repeated to cover the desired area. The codes were printed on colored paper and glued on each tactile model face.

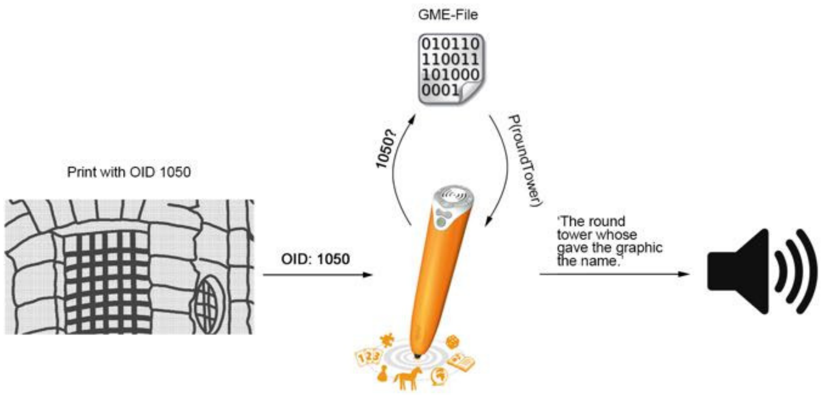


Figure 3: Functionality of the penreader tiptoi® from Ravensburger (www.tiptoi.com) [2].

4 Conclusion and Outlook

In summary we transfered a printed graphic into a tactile model and enhanced it with a local code accessible by the reading pen tiptoi® (cf. Fig 4a) which provided local audio information. We created an interesting, interactive, and joyful experience for all exhibition visitors. We achieved great impulses for the assignment from artwork to digitally generated tactile models especially for blind and visually impaired visitors of an exhibition. The work provides an interdisciplinary and innovative contribution for inclusion in museums via methods of media informatics. The results were approved with usability tests with blind, visually impaired, and seeing people. The results and solution approach can be transfered to a wide range of application areas. Currently we apply our method to transfer paintings, graphics, and sculptures to pop-up models and reliefs and extend them with the tiptoi® optical code as an catalogue for blind and visually impaired people (cf. Fig. 4b).

5 Acknowledgements

This work was supported in part by Dresden State Art Collections. We would like to express our deep gratitude to the following persons for supporting us in many different ways.

- To the curators of the SKD Dr. Gudula Metze and Iris Yvonne Wagner for the chance to realize such a project.
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- To the Prof. Dr. Gerhard Weber of the Technische Universität Dresden (TUD) for inspiration to use a penreader for acoustic information.

a) b)

Figure 4: a) tactile model extended with tiptoi® for blind and visually impaired people, b) pop-up model of the final tactile model with big contrasting lettering and Braille.

- Dr. Peter Heinrich Jahn for art historically correctness and interpretation of the art of Piranesi.
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- Loreen Pogrzeba for constructive criticism of the manuscript.

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Virtual Reality for usability experiments with a tour-guide Robot

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April 27, 2018

1 Introduction

Three robots are currently under development in the field of artificial intelligence at Univeristy of Applied Sciences Dresden. This article targets a experimental approach to optimize the update cycle of the robot using an example as a tour guide robot.

2 Motivation

At this moment, updating the robot is very complicated. After the development of a new update it must be tested directly on the robot.
This means that the robot is not available for normale use at this time. After installing the update, all test must be performed directly to collect data and create hotfixes. At the end some small tests with random visitors of the museum follow. Since this process takes a lot of time and effort compared to the small amount of resulting test data, the tests should be carried out in virtual reality.

3 Targets

The main objective is the creation of a simulation of the robot and the exhibition "Computer Technology" of the "Museum of Technology of Dresden and Saxony". With this VR robot, we make it possible to perform optic and behavioral tests without touching the current robot. Futhermore, we have the following positive side effects:

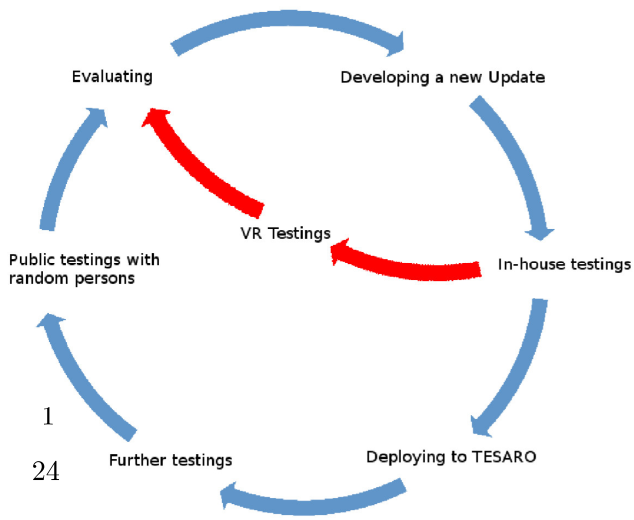

Figure 1: Blue: The traditional Updatecycle, Red: The Short way we want to use

- Reduction of test time
- Video recordings from different viewing directions possible (eg. Visitorview, Robotview, bird's-eye view, ect.)
- The real robot stays available during tests
- Tests can be performed simultaneously on different work stations

4 Results

All necessary aspects of the robot are simulated in a more or les correct way. The Interaction with the robot is possible in the same way as with the real robot. A first small study has shown that the experience is almost the same. Further work must be done in the following fields:

- Navigation and movement of the robot are a bit different.
- Interaction with the screen could be better.
- A large part of the exhibits are missing

Figure 2: Comparison of the VR and the Real exibition.

Navigation of Visually Impaired People in Urban Areas with Environment Transitions and Use of Public Transportation

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Abstract. There are many kinds of navigation systems for visually impaired people most of them focus only on indoor or outdoor navigation. We focused on the whole process of daily navigation in cities, i.e. combination of indoor and outdoor together with public transportation and use of text descriptions that can be generated from data structures.

1 Introduction

For the visually impaired people, it is vitally important to be able to independently navigate. The impossibility of this activity has an impact on their quality of life. Although many helping aids, devices, and navigational systems for visually impaired people exist nowadays, majority covers only part of daily navigational issues that visually impaired can encounter with, i.e. outdoor only or indoor only navigation systems. We propose way how to connect these parts into complex navigation system with environment transitions and use of public transportation, because it is daily reality of people who travel in cities.

2 Related Work

This work builds on the basis existing navigation system, which provides outdoor and indoor navigation for visually impaired people [1, 2]. It is based on landmark-enhanced navigational instructions that are automatically generated from modified data structures and side-walk network.

3 System of the Templates

We classified environment into outdoor, indoor, semi-indoor (passageways, underground vestibules) and semi-outdoor (courtyards, hospital compounds) categories, then we identified situations in cities that can users encounter with focus on public transportation (tram stations, underground stations, train stations or bus terminals) and environment transitions. For that purpose we use the system of navigation instruction templates, which incorporate all important data, to inform visually impaired person about his/her and provide meaningful action

Fig. 1. Experiment with visually impaired participant

to perform. The template for the tram station can look like this: **Description:** You are at isle station <StationName>. At isle are <StationObjects>. <Crosswalk/Underpass/Overpass> is at <front/back/middle> part of the isle. **Action:** After getting off, turn <Direction>. Have tram by your <left/right> hand. <Handrail/Roadway> by your <left/right> hand. Go <Distance> metres straight to <crosswalk/underpass/overpass> at <left/right>.

4 Conclusion and Future Work

For purposes of user testing were created prototype routes leading through city center of Prague, prototypes were created from existing Naviterier routes supplemented with our descriptions of stations, entrances and semi-outdoor environment. Two iterations of experiments were conducted with visually impaired participants.

The prototypes showed us that there are still problems with e.g. finding entrances or missing important landmarks. Future development will focus on the use of Bluetooth Low Energy Beacons that are expected to be used as route synchronization points and can help users to prevent mentioned errors.

Acknowledgements The research has been supported by the project Navigation of handicapped people funded by grant no. SGS16/236/OHK3/3T/13 (FIS 161 – 1611663C000).

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Preferences of visually impaired older adults regarding audio content consumption: A user study and design concept.

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Abstract. We present the results of user research and first design concept of audio-book player for visually impaired seniors. The user study was conducted in a form of qualitative semi-structured interviews with six blind participants. We identified fundamental functional and non-functional requirements and started the design process with describing the situational context by scenarios and storyboards, based on which we created the first design sketches.

1 Introduction

The risk of visual impairment increases with age. Although reading books is a hobby for many seniors, due to this disadvantage it can be inaccessible. The goal of this project is to create a new device, which will enable easy access to audio content for visually impaired seniors.

2 Related Work

The target group consists of seniors with severe visual impairment (blind, practically blind). The study participants live in Home Palata – a is specialised residential care institution for visually impaired seniors founded in 1888. Currently, there live more than 100 visually impaired seniors. The fundament framework of this research is described in [1].

3 User Study

We conducted six semi-structured interviews. The discussed topics were: how they read; where they read; what devices they use; and in which environment they read. We have found that the most popular reading method is the audio-book – a book read by a human speaker. Participants read primarily at home (in private). They use headphones only in public areas to avoid disturbing others. Many clients of Palata home use old devices, typically provided by family members. For instance, an MP3 player with small buttons, which are hardly usable for them. In contrary, some clients use new devices more specialized for seniors.

However, there are still substantial issues that compromise efficient usage. The devices don't support rewind function, and and the handling of content is quite complicated rather than based on concepts and metaphors already known by the target user audience.

4 Conclusion and Future Work

The new device should use a maximum of well-known metaphors and be tactile friendly. The Functional requirements are: volume control, skipping chapters, rewind, bookmark, and switching between saved books. We started the design process with describing the situation context by scenarios and story-boards. We decided that the book player should look like a regular book (see Figure 1). As a subject of the future work, We plan to produce several prototypes and evaluate them with representatives of target user audience.

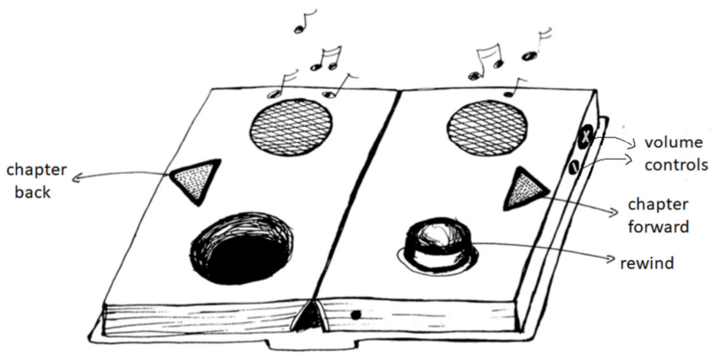

Fig. 1. Sketch of new audio player.

Acknowledgements This research has been supported by the project Navigation of handicapped people funded by grant no. SGS16/236/OHK3/3T/13 (FIS 161 – 1611663C000).

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Operator Station for Visualization and Control of Autonomous Unmanned Vehicles

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Abstract. Unmanned aerial vehicles (UAVs or drones) are nowadays commonly used for data acquisition, for monitoring dangerous places and for free time activities. Given their mobility and fast and often chaotic movement, following and selecting them can be quite hard. In cooperation with Agent Technology Center[2] and their UAV simulator our work was focused on creation of a visualization for the operator to control the drones and plan missions for them.

1 Introduction

The basic actions, that the operator needs to do are creation of a mission, assigning one or more drones to them and then start the simulation. Missions consists of three different actions: following a target, surveying a location and flying through defined waypoints. Even more complex or abstract actions like data acquisition or dangerous area monitoring can be decomposed into these three simple actions. Usually, the operator plans the missions over large areas, so there can be many objects on the screen at the same time; ie. multiple drones, surveillance areas or waypoints. Furthermore, there is a need for terrain and obstacle information.

2 Related Work

Quite the number of SDKs exists, that provide access to such services like Mapbox SDK[4]. Also, extensive work has been done on external labeling and we based our solution on an article about labeling small, fast moving objects in 2D by Balata et. al[3]. They provided multiple modes as fixed mode, dynamic mode and LabelFreeze mode, with selection error test results provided.

3 Method

The AgentFly Simulator has its own visualization[1], but it serves more for debugging purposes than for common use. It has no information about where we are flying and above what we are flying. It is also only in 2D, so you have no information about colliding paths.To solve this problem, we propose use of tile services - Mapbox and Mapzen[5] - to obtain satellite imagery, terrain height and information about buildings. We use external labeling for simulation objects.

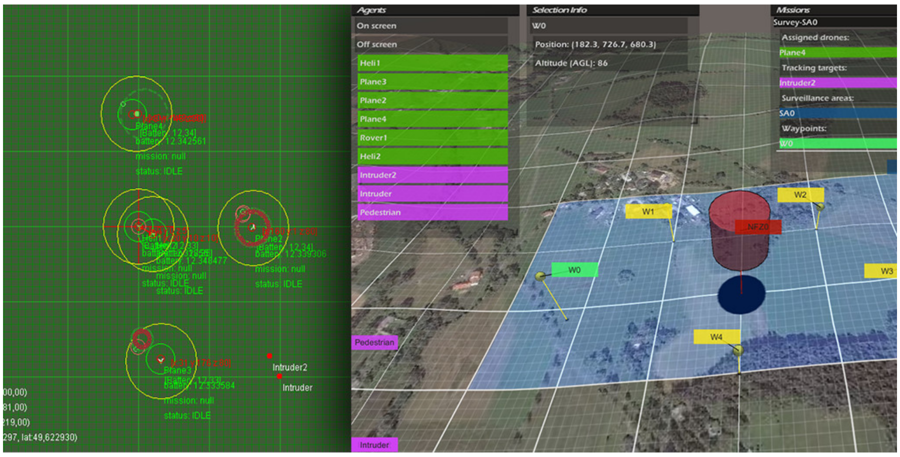

Fig. 1. Original 2D visualization on the left and our final prototype using external labeling on the right.

4 Evaluation

We have designed and implemented four prototypes. For the first prototype, we recruited 3 participants, for whom ever flying a drone was the only requirement. For the rest of the prototypes, we recruited 4 people from Agent Technology Center. In the test sessions we focused mainly on easing the planning of missions, fly path visualization and labeling. We needed to know, how the operator works, how visible the drones are and how detailed the terrain and fly path should be.

5 Conclusion and Future Work

After the last prototype, we didn't find any problems that would need immediate attention and fixing. Though we find out that connecting the visualization with Google Maps by using common map format KML could be useful or to integrate the visualization into the Google engine.

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